Projet Archipel

Feasibility Report

Synthesis

Archipel
Projet d'aménagement des eaux de l'Archipel de Montréal

PROJET ARCHIPEL
FEASIBILITY REPORT

SYNTHESIS

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PROJET ARCHIPEL
FEASIBILITY REPORT

The feasibility report is composed of 5 volumes entitled:

— Synthesis,

— Volume 1: Origine et évolution du projet (Origin and Evolution of the Project),

— Volume 2: La régulation des eaux et les aménagements en rive (Water Regulation and Shore Developments),

— Volume 3: L'aménagement hydroélectrique des rapides de Lachine (Hydroelectric Development of the Lachine Rapids),

— Volume 4: Liste des études (List of Studies).

PROJET ARCHIPEL — FEASIBILITY STUDY
SYNTHESIS — REPORT
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1. THE FEASIBILITY STUDY

1.1 Mandate and Objectives

In April 1979, the Minister of State for Planning and Development and the Minister of Energy created an interdepartmental committee to conduct a pre-feasibility study on the management of the waters of the Montréal archipelago. Since this study led to the formulation of a coherent water management hypothesis, the Conseil des Ministres decided on July 11, 1979 "to conduct a feasibility study on the management of the waters of the Montréal archipelago"[1]. In November 1979, it set up the mechanism for carrying out this study, which began in 1980[2].

The ultimate goal of the project was to improve the overall satisfaction that the population draws from its direct and indirect relationship with the water.[3] This goal was achieved by pursuing the following objectives:

— increase the population's access to both the water and the shores, and improve the conditions for aquatic recreational activities;

— reduce flooding;

— develop the Montréal archipelago's unused hydroelectric potential;

— protect and improve the ecological balance of aquatic and riparian ecosystems, and enhance wildlife habitats and resources;

— improve navigation in the waters of the archipelago;

— enhance intervention sites, including the improvement of inter-shore transit;

— contribute to the improvement of both drinking water supplies and wastewater dilution.

These objectives apply to all watereways of the complex hydraulic system which constitute the Montréal archipelago.

1.2 The Montréal Archipelago

The Montréal archipelago is located at the confluence of the fleuve St-Laurent and the rivière des Outaouais (Ottawa River). It is characterized by a series of lakes, rapids and a multitude of islands. Upstream, the lac des Deux Montagnes is fed by the rivière des Outaouais and flows into:

— the rivière des Mille Iles through the rapides du Grand Moulin;

— the rivière des Prairies through the Lalemant and Cap-Saint-Jacques rapids around Ile Bizard;

— lac Saint-Louis through the Vaudreuil and Sainte-Anne-de-Bellevue rapids around Ile Perrot.

Lac Saint-Louis flows into the La Prairie basin through the rapides de Lachine. Finally, the La Prairie basin flows into both the rapides du Sault Normand, upstream from the Montréal harbour and the Seaway. These waterways converge and flow downstream leaving the archipelago at Repentigny.

The archipelago includes more than 300 islands. Among these are two large-sized ones, Ile de Montréal and Ile Jésus, and two medium-sized ones, Ile Perrot and Ile Bizard. Several small archipelagos are distributed throughout this area, such as the Iles de Boucherville, the Mille Iles archipelago, the Iles de la Paix, etc.

The flow of the St-Laurent upstream of lac Saint-François is greatly regulated. Flooding of the St-Laurent does not peak at specific times during the year but extends over several months. The hundred-year flood flow in this portion of the fleuve Saint-Laurent is approximately 1.6 times its average flow rate.

The rivières des Outaouais system, on the other hand, is very irregular. A flood, with a 1% chance of occurring, can attain 5 times the average discharge. Its low water periods are also more severe, with discharges occasionally falling to one tenth of that in the Saint-Laurent.

The separation of discharge between the outlets of the lac des Deux Montagnes varies according to both its level and the level of lac Saint-Louis. During average low water periods, the lac des Deux Montagnes empties three-quarters of its outflow into the rivière des Prairies. During the average annual flood, lac Saint-Louis absorbs approximately half of the outflow.

Lac Saint-Louis evacuates its outflow through the rapides de Lachine. These rapids, which are the archipelago's largest, are of strategic importance for the balance of the region's water system. They control the water level of lac Saint-Louis and, as a result, indirectly control the water levels and flow rates upstream.

The archipelago's topography and water system explain Montréal's development and the unique value of its waters and shores. However, some potential for development exists and certain problems remain.

1,3 The Origins of the Project

Excessively high outflows from the Outaouais and the St-Laurent cause flooding in the region. Insufficient flows also cause damage to the quality of the water, the shores and potential for recreation. Finally, the water level is one of the major factors that explains the distribution of vegetation and wildlife habitats. Management of these levels could improve the productivity of the environment.

The archipelago's topographic conditions are such that large waterfalls are concentrated in certain areas. The main portion of the region's unused hydroelectric potential is at the rapides de Lachine.

These hydraulic and topographic factors dictate the natural equilibrium which is influenced by urbanization. Urban development causes increased occupation of the shore, promotes the use of the bodies of water (as a source of drinking water for the populace or as an area for waste discharge), and increases their recreational use. On most of the archipelago's shores, this development has been to the detriment of the public access to water, the aquatic recreation and the protection of the natural environment.

1. Decision No. 79-170, July 11, 1979.
2. Decision No. 79-250, November 14, 1979.
3. Projet Archipel, Feasibility Study, Progress Report, Synthesis, Ministère du Conseil exécutif, Secrétariat Archipel, Montréal, December 1981.

Projet Archipel is designed to correct these situations and is intended to constitute an integrated intervention centred around three main components:

— water regulation;

— hydroelectric energy production;

— shore development.

The need for an integrated approach to the problem of water management became apparent in the 1970s. Since that time, governments and municipalities have implemented programs of concerted action concerning the aquatic and riparian environment. These programs emerged from several studies aimed at highlighting a new, more balanced and more productive relationship between Montréal and its waters.

In 1970, the Commission québécoise d'étude des problèmes juridiques de l'eau tabled a report dealing with all aspects of water rights. This report concluded that an integrated institutional approach was necessary to surmount the problems resulting from developing this resource.

In 1971, Hydro-Québec resumed its studies of the development of the energy potential on the St-Laurent. The alternatives studied were not retained because of their poor economic performances. In addition, the environmental impact and lack of comprehension would have made the acceptance of these alternative difficult.

Between 1972 and 1978, the federal-provincial committee studying the St-laurent examined means for improving the quality of the water in the river. The P.A.E. (programme d'assainissement des eaux — Water Purification Program) will be based on the committee's work.

In 1974, the governments of Québec and Canada created the Committee of flow regulation, Montréal region. The Committee's mandate consisted of identifying solutions to problems caused by flooding and low water periods in the region. The Committee concluded that the possibilities of control were limited, considering the large quantities of water added upstream from the rivière des Outaouais and the St-Laurent. It proposed integrated action, in particular concerning the improved management of the rivière des Outaouais, the construction of a flow regulator at the entrance to the rivière des Mille Iles and the implementation of a by-law restricting development in the flood plain.

Projet Archipel falls under the extension of these projects. Its preferred means of action are interventions in the water system and measures for shore management. The project's integrated nature is achieved in particular by the institutional structure of the study's management.

1.4 The Structure of the Study

In deciding to conduct a feasibility study, the government also decided to provide the project with a unique institutional structure. Various government departments and public agencies were called upon to be promoters of the study; ministère des Affaires municipales, ministère de l'Énergie et des Ressources, ministère du Loisir, de la Chasse et de la Pêche, Office de la Planification et de Développement du Québec and Hydro-Québec.

The responsability for the study lay with the Minister of State for Planning and Development, before being transferred to the Minister of Energy and Resources, who also chaired the Comité ministériel Archipel. Eventually the responsibility for the study became that of the Minister of Municipal Affairs. The study is managed by a government coordinator, acting as Director of the Secrétariat Archipel. The Secrétariat is a technical body responsible for planning and integrating the studies conducted by the departments and agencies involved in the project. A Comité technique d'harmonisation, chaired by the coordinator and composed of representatives from the departments and agencies involved in the project, coordinates each body's contributions and ensures the efficient operation of the study.

Project progress reports were produced in December 1981, June 1982 and April 1984. These reports outlined how the project should be oriented, and enabled those involved to elaborate on and modify the study's priorities and mandates.

Consultation, discussion and coordination mechanisms were also established from the outset of the study. They culminated in June 1982 in a meeting uniting representatives from the government departments involved, Hydro-Québec, the archipelago's municipalities and intermediary bodies. This session resulted in a consensus and determined the orientation of the study's subsequent progress.

Finally, the establishment of an agreement protocol between the Canadian and Québec governments authorized the exchange of technical data concerning the project with the federal bodies concerned.

1.5 The Impact of the Study

The Projet Archipel feasibility study had a positive impact on many areas.

These effects were especially obvious in terms of knowledge acquired regarding the Montréal archipelago. Hydrometric data banks were constituted. The hydrodynamics of the bodies of water were simulated using mathematical and physical models. Ecological studies were conducted. Bathymetric and sediment maps were produced. The quality of the water and the sediments, the process of erosion and sedimentation, and the ice systems were all studied.

Biological surveys were conducted for several resources. Specific maps of the riparian vegetation were also prepared. Numerous studies attempted to understand the Montréal archipelago's biological changes and the links between its water system, its wildlife habitats and its resources.

The human environment was also researched in terms of land use, recreational needs and demands, cultural heritage and riverside landscapes, the shore's archeological potential, and the water's importance to the economy.

In some cases, original methods or methods not often used in Québec were employed. Examples include observations of ice by Landsat satellite, radiotelemetric studies of fish habitats and movements, sampling of drifting fish eggs to locate spawning grounds.

Technological advances were also made in terms of design. Methods for controlling contaminated sediments were elaborated. Hydro-Québec expanded its expertise in the area of quick currents, power stations without ice covers, the use of "bulb" turbines for harnessing low heads and the integration of hydroelectric projects in a heavily urbanized environement.

The expertise acquired concerning ice and "bulb" turbines should permit a considerable reduction in the cost of future hydroelectric projects.

2. WATER REGULATION

2.1 Evolution

The goal of regulation is to control the various extremes in water levels in the Montréal region. In its 1976 report, the federal-provincial Committee on flow regulation identified the technical solution for reducing flooding.

This solution involves the diversion of excess water from the rivière des Outaouais towards the St-Laurent through canals and flow regulators at the outlets of the lac des Deux Montagnes. The excess water would flow into lac Saint-Louis. Since this lake also floods under natural conditions, its capacity for draining into the St-Laurent also would have to be increased. This additional capacity would be provided by a canal in lac Saint-Louis upstream of the rapides de Lachine. Furthermore, the regulations structures could be used to increase water levels in certain bodies of water during low water periods by changing the flow distribution among the various bodies of water.

The 1976 report identified the technical solutions but also concluded that its implementation was not economically feasible notably due to the high cost of the canal at the rapides de Lachine. Projet Archipel's unique approach was to relate the control of these waters with the development of the rapid's energy potential. Although a canal required solely for level control purposes proved too costly, the addition of a hydroelectric power station may have made the project economically feasible. The pre-feasibility study conducted in 1979 concluded that it would be interesting to carry out a feasibilty study based on this hypothesis.

From this viewpoint, the production of hydroelectricity became essential in order to justify the project, since the expected revenue would pay the cost of the management of the diversion of excess water into lac Saint-Louis, and of the control of levels in lac Saint-Louis itself.

The original objective regarding flood control was to completely eliminate the damages due to this phenomenon in the Montréal region. The study's first hypothesis (1980-1982) led to the design of hydraulic and hydroelectric works capable of achieving this goal. The canals and excavations required to meet this need proved too costly. This complete control also had negative environmental impacts. A new design criterion was therefore adopted which aimed at eliminating as much damage as possible while attempting to attain an economic balance between costs and benefits. The protection of the natural riverside environmental was also considered.

The development of the hydroelectric project would greatly affect the progress and conclusion of the water regulation component. The technical, economic and environmental studies carried out by Hydro-Québec in 1985 have, in fact, shown that the hydroelectric project could not be envisaged in the short or medium term.

According to the initial forecast, the exclusion of the hydroelectric component should have ended hope of controlling flooding. However, the situation has changed. During studies which aimed at increasing the power station's profitability, model tests had identified the effectiveness of an intervention at the Lachine pier as a measure for increasing flood control. This particular intervention, whose hydroelectric efficiency has hitherto been unknown, could be carried out independently of the hydroelectric project. Combined with the use of the Seaway as a channel for draining floodwaters, this measure could constitute an alternative hypothesis for regulation. Nevertheless, it was only studied separately beginning in September 1985 when it was apparent that the hydroelectric component had little chance of development.

The degree of water control permitted by this second hypothesis is not identical to that forecast for the first one, particularly regarding the control of lac Saint-Louis. The hydroelectric works would ensure more effective flood management and include the flood regulation structure which would effect control during low water periods. However, as shown by subsequent studies, this second hypothesis would realize many of the initial regulation objectives while remaining economically profitable despite the absence of hydroelectric works. Moreover, it makes possible a number of developmental and ecological measures that are advantageous.

2.2 Conclusions regarding Flood Control

After the ministère de l'Environnement du Québec and the Secrétariat Archipel studied several alternatives, the following developments were judged most effective:

- construction of a spillway in the Seaway dike, in the Côte-Sainte-Catherine park;
- excavation and opening of the Lachine basin to contribute to the flow capacity in flood periods of the St-Laurent;
- rehabilitation and reinforcement of the two locks at Sainte-Anne-de-Bellevue (the older one is currently buried) for use as spillways during flooding;
- construction of a spillway at Ile Claude to increase the discharge capacity at Sainte-Anne-de-Bellevue.

The project composed of these four developments would reduce flooding in the region but would not eliminate it entirely. The project's minimum cost would be $97.5 million in 1984 dollars,[1] including the following:

- $13,5 million for the Seaway spillway;
- $49.3 million for the Lachine basin;
- $9.1 million for the Sainte-Anne-de-Bellevue locks;
- $25.6 million for the Ile Claude canal.

(These amounts do not include any interest costs or make allowance for inflation).

1. All costs and benefits quoted in this report are given in 1984 dollars.

This cost includes $6.2 million for removing and confining the 230 000 m³ of contaminated sediment from the Lachine basin, and $2.7 million for moving and expanding the Lachine marina. These projects are necessary and inseparable from the hydraulic works. The estimated cost also includes both the transportation to and disposal of excavated materials on sites which are less costly or where the environmental impact is acceptable.

The development's social benefits are estimated by the expected increase in property values due to the flood damage reduction. The benefits are evaluated at $102 million, spread throughout the archipelago's basins. This amont is 70% of the benefits that could be realized by completely eliminating flooding. The cost for flood control $88.6 million (environmental improvement work for the Lachine basin has its own advantages, which are not taken into account). Therefore, the net economic benefit is $13 million and the cost-benefit ratio of flood control is 1.15.

Economic performances differ depending on the development alternative. the most profitable projects are those of the Seaway spillway and the Sainte-Anne locks. The Lachine basin project enjoys the transfer of benefits from these other, more profitable interventions. However, these projects have positive effects on the basin: they improve the quality of the aquatic environment and make the basin a preferred site for nautical activities involving small craft.

The four developments may be carried out separately, thus making possible different variants with differing performances. For instance, there are variants whose cost-benefit ratio exceeds 1.15 or whose net benefit exceeds $13 million. However, they offer less flood control than the more comprehensive variant.

The environmental impact due to each intervention and level of flood control has been identified and appears to be acceptable.

Consultations were held with the municipalities and the agencies, especially federal, concerned. Although no authorization or formal support was sought, the project was received favorably.

The project composed of four developments is the one best suited to the flood control objective pursued during the feasibility study and may be carried out in stages. The developments concerning the Seaway spillway, the Sainte-Anne-de-Bellevue locks and the Lachine basin require the agreement and participation of federal authorities.

The hydraulic developments can lead to projects aimed at enhancing each site. A recreational and nautical development project was studied for the Lachine basin in order to make the basin a regional centre for such activities. The cost of this development scheme is evaluated at $8.7 million. The creation of a park on Ile Claude and an intershore link for pedestrians and cyclists were evaluated at $4.8 million.

2.3 Conclusions on the Management of Low Water Periods

One of the objectives of the feasibility study was to verify the feasibility of managing the low water flows and intermediate flows as part of the flood management with the following plans:

— a water management plan which would determine the conditions of environmental and social acceptability of a change in the water system, in particular outside of flooding peaks;

— an equipment plan which would achieve the management objectives and which could be justified economically and environmentally. Possible equipment consists of flow regulators fitted with mobile gates or layers of rockfill.

The chosen management plan defines the limits over and above which changes to the water system become more difficult to accept. The feasibility study shows that the room to manoeuvre for each of the basins is small, a fact which makes any control alternative difficult to justify economically. These regulators are considered too costly for the use which could be made of them within the limits authorized by the management plan. This conclusion was drawn after examining several alternatives. The design process used in studying this component consisted of gradually decreasing the degree of control, so as to render the costs compatible with the social value of the expected benefits.

The alternative that seems most likely to meet the feasibility study's objectives is composed of four mixed weirs at the outlets of Vaudreuil, Sainte-Anne-de-Bellevue, Cap Saint-Jacques and Lalemant. If this alternative is developed at the same time as the Sainte-Anne canal, so the excavated material may be used, its cost would then be $16 million, which is $9 million less than if imported materials were used.

The social expediency of the advantages of this alternative compared to its cost must also be judged. Setting up this equipment appears to be less advisable than building works permetting flood control.

3. SHORE DEVELOPMENT

3.1 Evolution

From the outset of the project, the objectives were to enhance both the shores and development sites and to both improve access to the water and permit open-air and nautical activities as a means of restoring the population's enjoyment of the water.

This component of Projet Archipel, called "aménagement des rives" (shore development), received particularly marked support at the discussion and coordination session in June 1982. This support resulted in a more global approach. The Secrétariat Archipel and the MLCP (ministère du Loisir, de la Chasse et de la Pêche) concentrated their efforts on creating a proposal affecting the whole of the archipelago's territory. This proposal was presented in the April 1984 progress report and led to the government's decision of September 1984 to entrust the MLCP with realizing this entire project. to be designated the Parc national de l'Archipel.

However, the development of zones for possible installation of hydraulic and hydroelectric works continued to be included in the studies of Projet Archipel itself, since the measures proposed in these zones were directly linked to interventions in the water system. Most of the devel-

opment proposals contained in the feasibility report, whether for recreational, ecological or wildlife purposes were designed to be eventually integrated into the Parc national de l'Archipel.

Provision was also made for the development scheme even if the hydraulic works were not constructed.

Development proposals were made for the La Prairie basin and lac Saint-Louis. They took advantage of large amounts of materials originating particularly from excavations in the Lachine basin and the Seaway spillway.

These excavated materials could be disposed of less expensively and with less environmental impact outside of the development proposals studies. These development schemes should therefore be seen as proposals submitted to the various municipal, provincial and federal agencies involved. They were designed from this viewpoint and should find promoters among the agencies usually involved in these fields.

3.2 The Lac Saint-Louis and La Prairie Basin Development Schemes

The development schemes that could use materials excavated from the Lachine basin area:

- the recreational and tourist development of the Ancienne Centrale site, designed for observation of the rapides de Lachine ($4.4 million, but with a saving of $0.2 million in transportation costs compared with the less costly solution of disposing the excavated material by transportation to the Kahnawake quarries);
- the stabilization of erosion-sensitive banks, at LaSalle and at Dorval and Dixie islands ($0.6 million in development costs with a saving of $0.5 million in transportation costs);
- development of a beach and nautical activities site at Verdun (development costs of $22.9 million and additional transportation costs of $0.4 million);
- development of a park and beaches along the Seaway dike (development costs of approximately $50 million under the maximum development hypothesis, additional transportation costs of $18 million);
- creation of a beach-island and other small islands for wildlife in the middle of lac Saint-Louis ($7.2 million in development costs and an additional $1.8 million in transportation costs);
- decontamination of lac Saint-Louis by creating six enclosures for confining contaminated sediments, a technique developed within the context of the project (maximum development costs of $27 million, additional transportation costs of $6.5 million);
- restoration of the Iles de la Paix, including protection against erosion, and wildlife development schemes (development costs of $4.7 million and additional transportation costs of $1.3 million).

The material excavated from the Seaway spillway could be used to decontaminate and to develop the small La Prairie basin ($14.8 million without additional transportation costs).

It would also be possible to carry out any of these developments individually. The quantity of materials destined for simple disposal areas would be decreased by the amount required for the development schemes selected.

Among the development schemes proposed, three are of major importance for the region. Nevertheless, their cost is relatively high, they involve considerable encroachments on the aquatic milieu and they have significant environmental impacts. However, their realization would change conditions for developing the La Prairie basin and would improve the lac Saint-Louis environment. These schemes are the development of the Verdun bank, the decontamination of lac Saint-Louis and the development of the Seaway dike. The functions fulfilled by these development schemes (decontamination and provision of bathing and nautical facilities) could be called upon to justify an intervention in the aquatic milieu.

The other development schemes do not represent any particular technical difficulties, and involve costs and encroachments on the aquatic domain which seem relatively moderate with regard to both the anticipated social advantages and the benefits for the area's wildlife.

The merit of each of these proposals should be evaluated by the principal parties involved, which are the ministère du Loisir, de la Chasse et de la Pêche, ministère de l'Environnement du Québec, Environnement Canada, Voie Maritime du Saint-Laurent, Montréal Urban Community, the municipalities of LaSalle, Verdun and the riverside municipalities of the small La Prairie basin. These organisations were already consulted when the developments were being proposed. However, they have not had the opportunity of making their views known on the final proposals submitted in this feasibility report.

4. HYDROELECTRIC ENERGY PRODUCTION

4.1 Evolution

At the outset of the study, the traditional concept used by Hydro-Québec made provisions for an ice cover in front of the power station to ensure its operation in winter. Given the twofold objective of maximum recovery of the hydroelectric potential of the rapides de Lachine and of complete flood control, the implementation of this concept required a large excavation upstream of the power station. A tailrace channel proposed from lac Saint-Louis to the La Prairie basin, added to this excavation.

During the discussion and coordination session of June 1982, it became evident that, as originally designed, this project was too costly, and that it posed considerable environmental problems. The main difficulty was that only 10% of the outflow of the St. Laurent remained in the rapides de Lachine, thus making difficult the maintenance of the rapids.

Following these observations, an effort to improve the project included a revision of certain design criteria, notably with regard to the degree of flood control. This resulted in a new concept for the hydroelectric component, which consisted of a power station operating in winter without an ice cover in the forebay. Combining these two elements permitted a new generation of hydroelectric alternatives which considerably reduced excavation and costs. These alternatives also improved the prospect of developing the rapides de Lachine by maintaining a higher discharge than that provided for in the previous concept.

Two winters of observation and studies on the behavior of the ice at the rapides de Lachine contributed to ensuring the technical feasibility of the new concept. The improvements decreased the cost of production per kilowatt by almost 60%. Upon completion of the preliminary studies in September 1984, the best alternative of hydroelectric production studies (variant 18) ranked fourth among Hydro-Québec's basic projects; and therefore passed to the pre-project stage.

This stage, completed in December 1985, consisted of studying in more depth certain technical and environmental aspects of variant 18 and of revising its costs.

Variant 18 includes:

— a power station on the south shore, between the shoreline and Ile au Diable, directly upstream of the rapides de Lachine;

— a flow regulator, equipped with mobile gates, damming the St. Laurent and connecting the power station to the north shore at LaSalle;

— a spillway, located on the south shore beside the power station;

— excavation of a forebay and a tailrace.

Variant 18 also makes provision for:

— repair of a spillway buried in the Seaway dike upstream of the Côte-Sainte-Catherine locks;

— excavation of a canal in the St. Laurent riverbed at the Lachine basin;

— alteration to the bed of the rapides de Lachine, made necessary by the new distribution of outflows by the development of a restoration system upstream of the power station and by the constraints arising from the evacuation of the ice;

— a system of ice retention composed of a boom and islands at the lac Saint-Louis outlet;

— rehabilitation of the LaSalle shore and protective works for the shore at Kahnawake;

— management of excavated material in the aquatic environment at Verdun, Ancienne Centrale and along the Seaway dike in the extension of Côte-Sainte-Catherine park;

— daily management of the water level in Lac Saint-Louis according to an established management plan.

These developments also provide the opportunity to create a new intershore link across the works, between the Rive-sud and Ile de Montréal, as well as a riverside park of some 110 hectares on the fill deposited along the Seaway dike.

Construction would last about seven years. It would be carried out mainly on the south shore, but also on the north shore at the Lachine basin, at Ancienne Centrale, at Verdun and in a portion of the bed of the rapides de Lachine.

4.2 Conclusions on the Hydroelectric Component

After the pre-project studies, it may be concluded that the development scheme proposed for the rapides de Lachine permits the maintenance of an environment of very turbulent water and ensures the presence of habitats that are advantageous for turbulent water fish. It respects some of the overall components of the landscape and offers an interesting view.

However, results of the studies do not guarantee acceptable restoration of the current biological and esthetic value of the rapids. The possibility of placing adequate substrates to compensate for losses of habitat surfaces and the decrease in shoreline suitable for spawning appears uncertain. The means of maintaining the range and diversity of the water formations, such as white water and standing waves, is unknown.

Hydroelectric developments obstruct the passage of certain species of fish. Another major impact is the disruption of heron and night heron populations. The site would be disturbed for 10 to 15 years, given a 7-years duration of construction. During construction, the major social impact would be the deterioration of the quality of life for the residents of the north shore and their loss of access to the St. Laurent.

In economic terms, the alternative has deteriorated since 1984. At this time, production was expected to be 536 MW in the month of January, at a cost of $1.05 billion (1984 dollars). The cost ratio compared to that of LG-1, Hydro-Québec's best project, was 1.1. Today, forecasts are that the power station would produce 418 MW, at a cost of $1.25 billion (1984 dollars). Its cost ratio compared with LG-1 is 2.30. The costs of LG-1 have decreased, and the project's costs and production have evolved unfavorably due partly to further ice studies and the project's environmental requirements. The project now ranks 9 th among Hydro-Québec projects. Its implementation would be possible after that of NBR and Eastmain-1 around the year 2030 if domestic demand grows at an annual rate of 3.4%. Advancing the project does not seem economically justifiable.

Changes in the demand forecast during the feasibility study explain the delay of construction. Forecasts for annual growth in domestic energy demand dropped from 6.1% in 1981 to 3.4% in late 1985.

Given these observations, it is recommended that all prospects of carrying out the hydroelectric component in the short or medium term be abandoned and that no complementary study be undertaken in the short term. It is also recommended that, before making any possible decision for carrying out the project, studies aimed at improving the power station's productivity and increasing the guarantees for maintaining the current value of the rapides de Lachine after development be conducted.

5. GENERAL CONCLUSION

These are the conclusions of the feasibility study:

— The technical feasibility of a power station operating without a stable ice cover upstream has been proven.

— Despite this technical innovation, the hydroelectric development of the rapides de Lachine cannot be envisaged in the short or medium term given the forecasts for growth of domestic demand for electricity. In effect, its economic performance is less advantageous than that of other Hydro-Québec projects. In environmental terms, we do not possess all guarantees for the restoration of the esthetic and biological value of the rapides de Lachine.

— The hydroelectric project was intended to permit management of the water levels of lac Saint-Louis and to increase the capacity of the rapides de Lachine in periods of flooding. Despite the fact that this phase was not retained, the study permitted establisment of technical feasibility of satisfactory flood reduction in the Montreal region.

— The alternative which best attained the project's objectives is comprised of a new spillway in the Seaway dike, the bassin de Lachine excavations, the work on the Saint-Anne-de-Bellevue locks and a spillway channel across Ile Claude. The cost of this variant is estimated at $97.5 million (1984 dollars). The economic evaluation of the social benefits procured by flood control demonstrates its profitability. This variant may be carried out in stages.

— Development of recreational and tourist potential at the Lachine basin and at Ile Claude was studied. The additional costs are $8.7 million and $4.8 million respectively in 1984 dollars.

— Water level management in low flow periods with flow regulation is too costly. The alternative most likely to meet the objectives of feasibility study at a reasonable cost consists of rockfill weirs at the lac des Deux Montagnes' four outlets. These would cost $16 million (1984 dollars) if they were constructed at the same time as the Ile Claude spillway. This project is less advantageous than that which permits flood control.

— A number of development schemes were studied for lac Saint-Louis and the La Prairie basin. The schemes attempted to use the excavated material from the bassin de Lachine and the Seaway spillway. The costs would be higher if the schemes were carried out independently of the hydraulic works.

— Three of the proposals apply on a regional scale: the development of a park, beach and marina at Verdun ($23.3 million in 1984 dollars), the confinement of lac Saint-Louis' contaminated sediments ($33.5 million in the maximum hypothesis), and the development of beaches along the Seaway dike ($68 million in the maximum hypothesis). They nevertheless entail considerable encroachments on the aquatic milieu and have environmental impacts.

— The other development schemes studied were: the recreational and tourist development of the Ancienne Centrale site at LaSalle ($4.2 million), the stabilization of erosion sensitive river banks, at LaSalle and at Dorval and Dixie islands ($0.1 million), the creation of a beach-island and small island for the wildlife of lac Saint-Louis ($9 million), the restoration of the iles de la Paix ($6 million), and the decontamination of the small La Prairie basin (14.8 million). Each of these development proposals should be assessed on its own merits by the principal organizations concerned.

— The feasibility study considerably increased the knowledge of the archipelago's waters and shores in hydraulic, physical, ecological, social and economic terms. New techniques were applied. The expertise acquired should permit appreciable cost reductions for future hydroelectric projects.

LIST OF PRINCIPAL TECHNICAL REPORTS

Secrétariat Archipel, 1986a,
Projet Archipel, Étude de faisabilité, Rapport technique no 1: **Les ouvrages hydrauliques,** Gouvernement du Québec, April 1986.
Presentation of the alternatives studied: technical and hydraulic characteristics of works, construction, costs.

Secrétariat Archipel, 1986b,
Projet Archipel, Étude de faisabilité, Rapport technique no 2: **Synthèse technique sur la gestion des eaux,** Gouvernement du Québec, April 1986.
Management goals, selection of management plans, hydraulic data, model simulation and results.

Secrétariat Archipel, 1986c,
Projet Archipel, Étude de faisabilité, Rapport technique no 3: **Les propositions d'aménagement,** Gouvernement du Québec, April 1986.
Problems of shore development within the context of the project, details of development schemes for development sites in lac Saint-Louis and the bassin de La Prairie.

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Projet Archipel, Étude de faisabilité, Rapport technique no 4: **Évaluation des effets sur l'environnement, rapport synthèse** prepared by André Marsan et Associés Inc., Gouvernement du Québec, April 1986.
Positive and negative impact of implementing works development schemes (construction and development) and of water management.

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Projet Archipel, Étude de faisabilité, Rapport technique no 5: **Détermination des avantages économiques d'une réduction des inondations,** prepared by Econosult-Lavalin Inc., Gouvernement du Québec, March 1986.
Cost-benefit analysis of flood control.

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Projet Archipel, Étude de faisabilité, rapport technique no 6: volet hydroélectrique, rapport synthèse sur les études de faisabilité techniques et environnementales, Résumé, December 1985, 51 p. 10 plates.

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Projet Archipel, Étude de planification, December 1985, 23 p., 3 appendices.

Roche, 1985a,
Avant-projet Archipel, Rapport des études environnementales, volume 1, Naissance d'un projet bien particulier, Direction Environnement, Hydro-Québec, November 1985, 234 p.

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Avant-projet Archipel, Rapport des études environnementales, volume 2, Un milieu à connaître, Volumes I and II, Direction Environnement, Hydro-Québec, November 1985, 431 p., 282 p.

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Avant-projet Archipel, Rapport des études environnementales, volume 3, Gestion du lac Saint-Louis, Direction Environnement, Hydro-Québec, November 1985, 226 p.

Roche, 1985d,
Avant-projet Archipel, Rapport des études environnementales, volume 4, Réaménagement des rapides de Lachine, Direction Environnement, Hydro-Québec, November 1985, 363 p. and appendices.

Roche, 1985e,
Avant-projet Archipel, Rapport des études environnementales, volume 5, Un aménagement innovateur, Direction Environnement, Hydro-Québec, November 1985, 359 p.

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Avant-projet Archipel, Rapport des études environnementales, volume 6, Insertion au milieu, Direction Environnement, Hydro-Québec, November 1985, 369 p.

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Avant-projet Archipel, Rapport des études environnementales, volume 7, Dossier cartographique, Direction Environnement, Hydro-Québec, November 1985, 53 plates.

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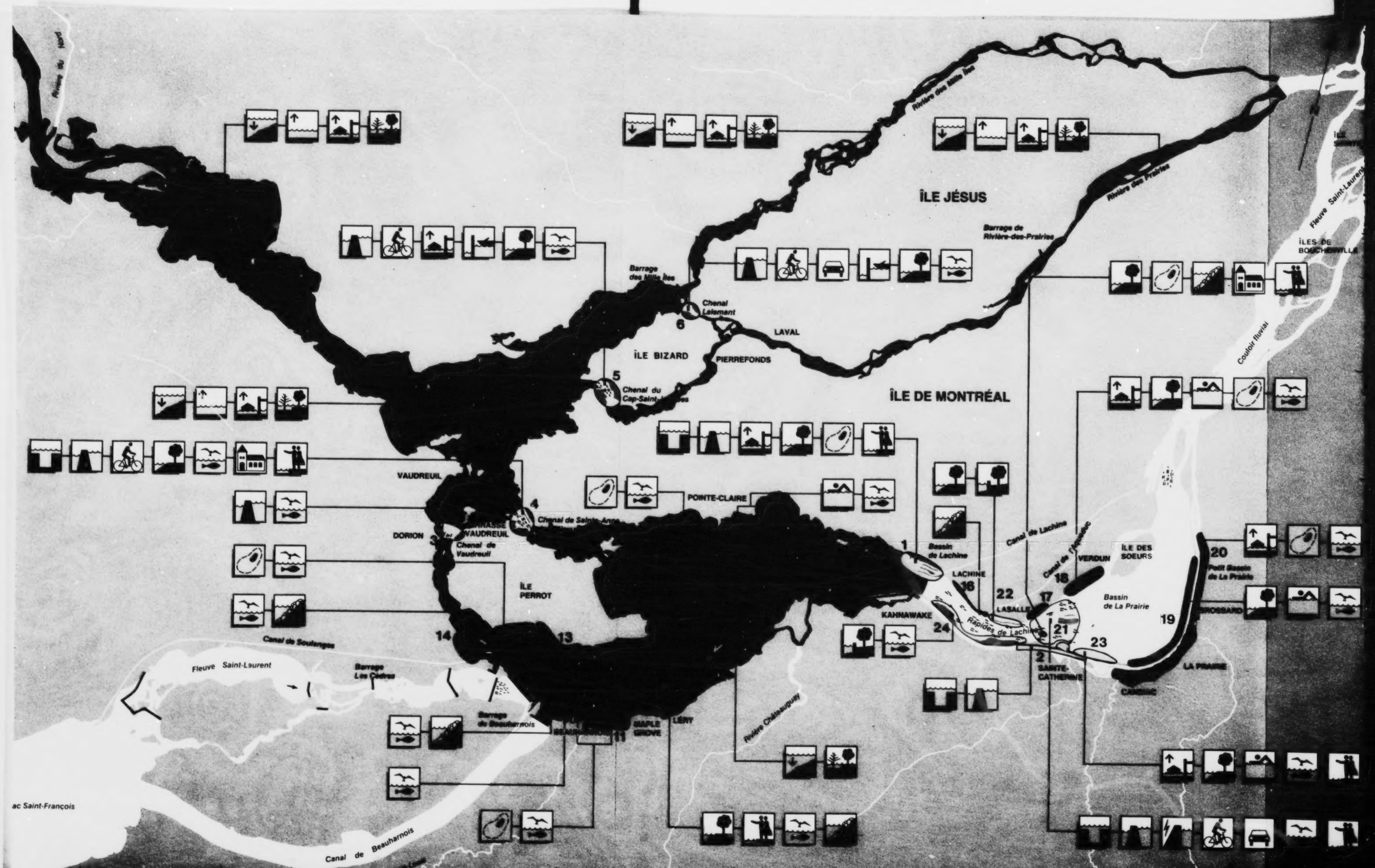
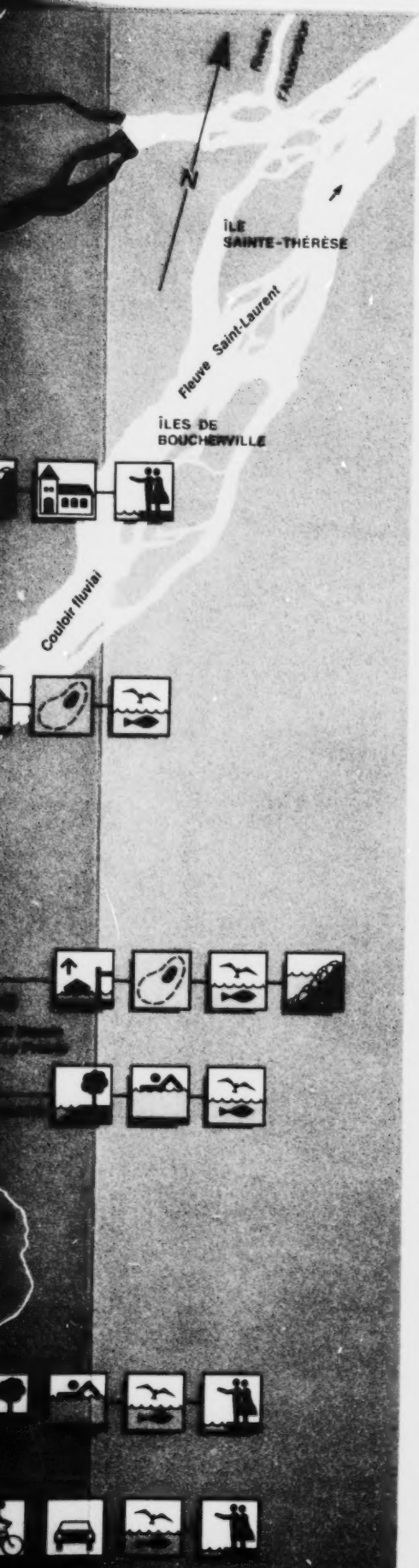

Rivière du Nord
Rivière des Mille Îles
ÎLE JÉSUS
Rivière des Prairies
Barrage de Rivière-des-Prairies
Fleuve Saint-Laurent
ÎLES DE BOUCHERVILLE
Couloir fluvial
Barrage des Mille Îles
Chenal Lalemant
6
LAVAL
ÎLE BIZARD
PIERREFONDS
5
Chenal du Cap-Saint-Jacques
ÎLE DE MONTRÉAL
VAUDREUIL
4
Chenal de Sainte-Anne
POINTE-CLAIRE
DORION
Chenal de Vaudreuil
ÎLE PERROT
1
Bassin de Lachine
Canal de Lachine
Canal de l'Aqueduc
VERDUN
ÎLE DES SOEURS
LACHINE
16
18
20
Petit Bassin de La Prairie
22
17
LASALLE
Bassin de La Prairie
19
KAHNAWAKE
24
Rapides de Lachine
21
23
2
SAINTE-CATHERINE
LA PRAIRIE
CANDIAC
Canal de Soulanges
14
13
Fleuve Saint-Laurent
Barrage Les Cèdres
Barrage de Beauharnois
MAPLE GROVE
11
LÉRY
Rivière Châteauguay
ac Saint-François
Canal de Beauharnois



Archipel
Projet d'aménagement des eaux de l'Archipel de Montréal

PROJET ARCHIPEL étude de faisabilité

PRÉSENTATION DES INTERVENTIONS ÉTUDIÉES

LES INTERVENTIONS INDÉPENDANTES DU PROJET HYDROÉLECTRIQUE

LA RÉGULATION DES EAUX

SITES D'OUVRAGES HYDRAULIQUES

1 Bassin de Lachine
2 Voie maritime
3 Exutoire de Vaudreuil
4 Exutoire de Sainte-Anne-de-Bellevue
5 Exutoire du Cap Saint-Jacques
6 Exutoire Lalemant

GESTION DES PLANS D'EAU

7 Lac Saint-Louis
8 Rivière des Prairies
9 Lac des Deux Montagnes
10 Rivière des Mille Iles

LES AMÉNAGEMENTS COMPLÉMENTAIRES

LAC SAINT-LOUIS

11 Rives de Beauharnois. Maple Grove. Léry
12 Secteur nord du lac Saint-Louis
13 Anse au Sable
14 Pointe-des-Cascades
15 Îles de la Paix

BASSIN DE LA PRAIRIE

16 Rive de LaSalle
17 LaSalle. Ancienne Centrale
18 Rive de Verdun
19 Digue de la Voie maritime
20 Petit bassin de La Prairie

LES INTERVENTIONS RELIÉES AU PROJET HYDROÉLECTRIQUE

21 **LES OUVRAGES HYDROÉLECTRIQUES**

LES AMÉNAGEMENTS EN RIVE

22 Levée de LaSalle
23 Parc de la Côte Sainte-Catherine
24 Rive de Kahnawake

NATURE DES INTERVENTIONS

OUVRAGES HYDRAULIQUES OU HYDROÉLECTRIQUES

- Canal d'évacuation
- Ouvrage régulateur ou seuil
- Remblais contre les inondations
- Centrale hydroélectrique et aménagement des rapides

LIENS INTER-RIVES

- Lien cyclable et piétonnier
- Lien routier

RÉDUCTION DES INONDATIONS

DIVERS

- Mise en valeur du patrimoine
- Mise en valeur touristique

LOISIRS

- Gestion des niveaux à des fins récréatives
- Amélioration des conditions de navigation de plaisance
- Écluse
- Parc riverain
- Plage ou bassin de baignade

ENVIRONNEMENT NATUREL

- Gestion des niveaux à des fins environnementales
- Confinement de sédiments contaminés
- Aménagements écologiques
- Travaux de protection contre l'érosion

Gouvernement du Québec
Ministère du Conseil exécutif
Secrétariat Archipel

Gouvernement du Québec
Ministère des Affaires municipales
Secrétariat Archipel